

## CONSERVATION MANAGEMENT OF THE AALENIAN STAGE GSSP IN FUENTELSAZ (CASTILLA-LA MANCHA, SPAIN)

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**Abstract.** The Global Boundary Stratotype Section and Point of the Toarcian-Aalenian Boundary (Lower-Middle Jurassic) in Fuentelsaz Section is the first GSSP defined in Spain. Among the requirements of the ICS for the choice of the best boundary level are accessibility to the type-section and free access for research, and guarantees from the respective authority concerning to the free access and the permanent protection of the site. In our point of view, the most suitable protection figure to safeguard the fulfilment of the ICS's requirements according to the Spanish Conservation Policy and Legislation is the Natural Monument. This paper deals with the conservation management and classification of the Fuentelsaz area as a Natural Monument, being the Comunidad de Castilla-La Mancha Authorities the ones that have to take the necessary steps to protect the site.

**Riassunto.** La Sezione e Punto Globale di Stratotipo per il limite Toarciano-Aaleniano (Giurassico inferiore-medio) nella Sezione di Fuentelsaz è il primo GSSP definito in Spagna. Tra i requisiti dell'ICS per la scelta del miglior livello del limite ci sono la raggiungibilità della sezione-tipo ed il libero accesso per la ricerca, e garanzie da parte delle rispettive autorità riguardo il libero accesso e la protezione permanente del sito. Secondo il nostro punto di vista, il profilo di protezione più appropriato per tutelare l'adempimento delle richieste ICS, in accordo con la Politica e Legislazione Spagnola di Conservazione, è il Monumento Naturale. Questo lavoro tratta la gestione della conservazione e la classificazione dell'area di Fuentelsaz come un Monumento Naturale, dal momento che le Autorità di Comunidad de Castilla-La Mancha sono quelle che devono intraprendere i passi necessari alla protezione del sito.

### Introduction

Nowadays the establishment of global chronostratigraphic standards is one of the main objectives of the International Commission on Stratigraphy (ICS). The Fuentelsaz Section, located at Guadalajara Province, Castilla-La Mancha Community, Spain (Fig. 1) was proposed for the first time in 1991 as a candidate for the Global Boundary Stratotype Section and Point (GSSP) of the Aalenian Stage within the Aalenian Working Group Meeting of Skye (Scotland). Afterwards this Section has been involved in a long process of discussions, over ten years, that took place in several Jurassic Working Group Meetings and Symposia: Poitiers (France) 1991, Marrakech (Morocco) 1994, Mendoza (Argentina) 1994, Nuévalos-Freiburg (Spain-Germany) 1996 and Vancouver (Canada) 1998. In this last Symposium organised by the International Subcommittee on Jurassic Stratigraphy (ISJS) the resolution to define the GSSP of the Aalenian Stage in Fuentelsaz was presented. Finally, it was ratified by the ICS of the International Union of Geological Sciences (IUGS) during the 31<sup>st</sup> International Geological Congress (Rio de Janeiro, Brasil, 2000).

Conforming to the guidelines of the ICS about the requirements of any GSSP (Remane et al. 1996), multidisciplinary studies at Fuentelsaz Section were carried out. First of all, the detailed biostratigraphical and chronostratigraphical framework was provided by the ammonite

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assemblages (Goy & Ureta 1987, 1991). Fuentelsaz displays one of the best worldwide ammonite record for documenting the evolutionary lineage within the sub-families Grammoceratinae and Lioceratinae as well as the early development of the *Leioceras* genus. Increasing the interest and the importance of Fuentelsaz outcrops, the research on other fossil invertebrates such as brachiopods (García-Joral et al. 1990) was undertaken. In the nineties, Fuentelsaz has been studied by means of different methodologies and points of view resulting in several multidisciplinary papers (Goy et al. 1994, 1996, 1999b) that have involved sedimentology, macro and micropalaeontology (ammonites, brachiopods, bivalves, foraminifera, ostracods, calcareous nannoplankton and palynomorphs), magnetostratigraphy, geochemistry and mineralogy, and carbon and oxygen isotopes, as well as other specific papers about brachiopods (García-Joral & Goy 1995) and foraminifera (Herrero & Canales 1997). The synthesis of all these data can be found in Cresta et al. (2001).

#### Basic data on the site proposed for protection

The Fuentelsaz Section is located in eastern Spain. Geographically, the Lower-Middle Jurassic boundary outcrops, in which it is included, are situated in the Castilian Branch of the Iberian Chains. The site is placed inside sheet No. 464 Used of the National Geographic Map, scale 1:50.000 (UTM coordinates: X: 59845, Y: 45836; geographic coordinates: latitude 41° 04' 48"N, longitude 1° 49' 41"W). From an administrative point of view it falls within the Guadalajara province, in the Autonomous Region of Castilla-La Mancha, very close to the border with the Autonomous Region of Aragón.

The Toarcian materials (Lower Jurassic) and the Aalenian materials (Middle Jurassic), consist of alternating marls and limestones, reaching a considerable thickness at this point (Fig. 1). The marls are predominant in the Aalensis and the Opalinum Zones up to the middle part of the Comptum Subzone. The limestones are predominantly mudstones and bioclastic wackestones. They outcrop on the south slope of the Cerro Cabeza Quemada, at an altitude of 1120 m, in a tributary ravine of the Arroyo del Val, part of the fluvial net of the Piedra River, which in turn is part of the fluvial basin of the Ebro River.

The outcrop which needs to be protected is relatively small, being about 1000 m in length and 500 m in wideness, where a total protection area (or alert area) of about 6 km<sup>2</sup> is considered to be enough.

#### Conservation needs of the Fuentelsaz Section

The conservation of interesting geological (and biological) sites, as the one we are dealing with, is essential for the preservation of our scientific heritage.

The philosophy that motivated scientists from different countries to start in 1996 the Geosites project under the patronage of the International Union of Geological Sciences (IUGS), has been taken into account when dealing with the conservation needs of the GSSP of the Aalenian Stage at Fuentelsaz. We understood that it is necessary to give an objective basis on which to build any initiative at a national –or international– level, in relation to the protection of this unique site.

First of all, it is important to transmit to the autonomic and state administrations, that the Fuentelsaz Section presents several assets which suggest not just its conservation, but also demand some guarantee that it will not be harmed beyond repair. This site gathers, among others, the following qualities:

- It has a high representativity, being the most complete and expressive way of a limit of the stratigraphic record. It should allow the maximal and most exhaustive understanding of the nature and origin of the phenomenon it represents.

- It corresponds to a singular section, unique at a global scale, which has to act as a chronostratigraphic reference in interregional correlations.

- It should enable the accomplishment of global multidisciplinary studies, for which it is necessary to consider a disposability and potentiality criterion. This is due to the practical necessities of science, which may require later studies, verifications and reinterpretations.

It can also be used as a standard, with educational and cultural aims. We also consider, as Wimbledon et al. (2000), that our international geological heritage is essential to science and education, and is a responsibility which should be shared by all geological scientists, and of course, in a special way in our case, by central and peripheral (autonomic and local) administrations.

#### Dangers or risks of destruction or deterioration

For the time being, imminent risks of destruction or deterioration of this site are not known, at least in the short run. The section is easily accessible and is located about 500 m from the last houses of the Fuentelsaz village. This village, although it was relatively important in historical times inside the Señorío de Molina de Aragón, in which it is included, nowadays has a population of about 300 inhabitants. The outcrops which need to be protected are separated from the village by a small valley, with non-irrigated agricultural crops, which can hardly expand into the slope where the GSSP of the Aalenian Stage is placed.

On the other hand, in the last few years the village has had a low development, with a negative demographic growth. New buildings have been built along the road leading to the interprovincial road which links Molina de Aragón (Guadalajara) with Nuévalos (Zaragoza). The

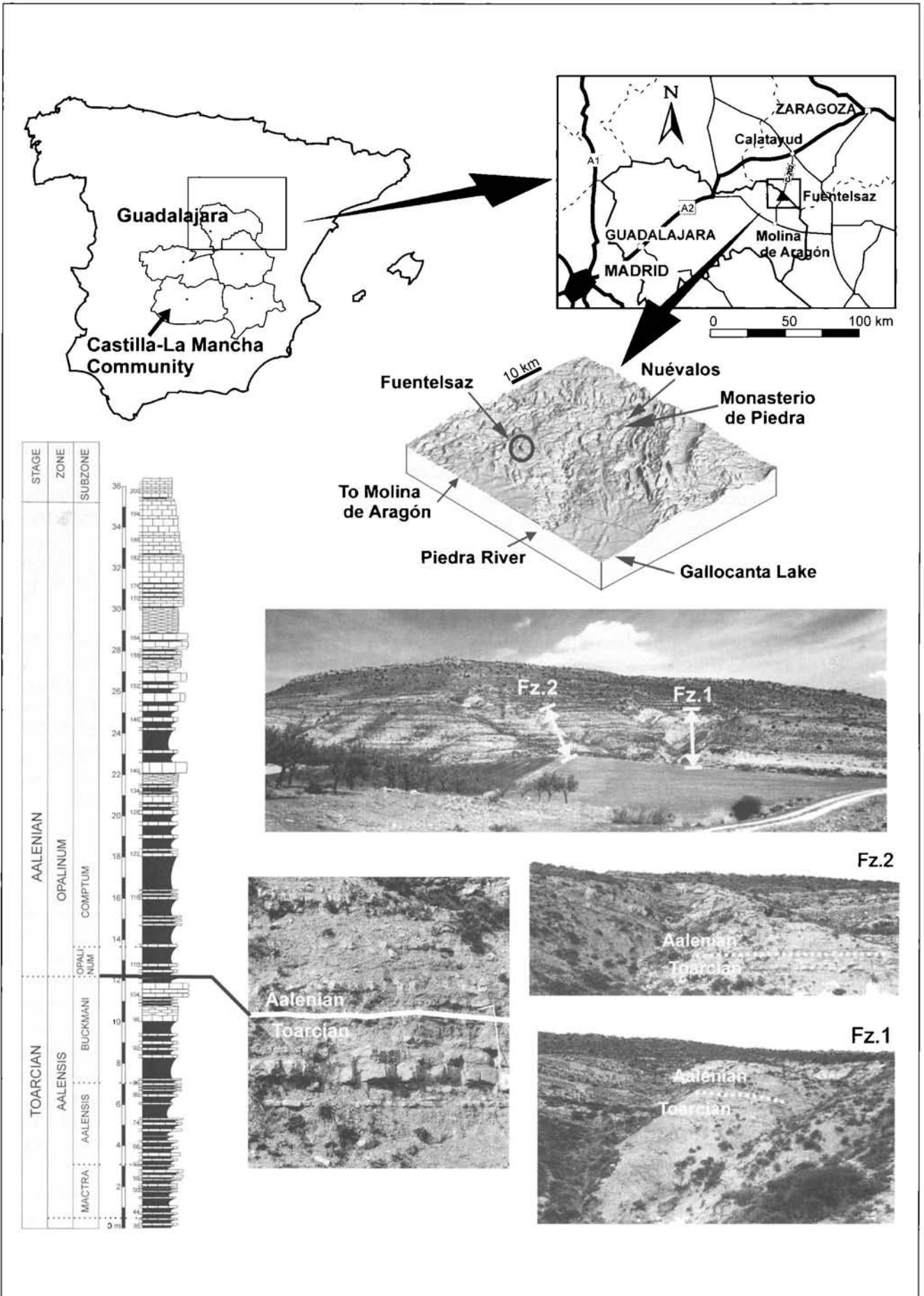


Fig. 1 - Location and panoramic view of the Fuentelsaz outcrops, stratigraphic profile and position of the GSSP of the Aalenian Stage.

economy of the village rests mainly on agriculture and does not have any kind of industry or mining exploitation in its surroundings, which may represent a noticeable risk for the site.

### **Actions towards the conservation and sociocultural development of the Fuentelsaz Section**

The UNESCO establishes that the fossils and palaeontological sites belong to the cultural heritage as part of the Earth, according to the agreement on the protection of World Natural Heritage, of November 1972, subscribed by Spain in its Law of 02-05-75. Its protection is contemplated in the laws on Natural Heritage of each country [for Spain in Law 4/1989, of March 27, on the conservation of Natural Areas (BOE no. 74, 28-03-89, Art. 12), and in some other autonomic laws]. This protection refers to the creation of Natural Reserves and Monuments –palaeontological sites of special interest are explicitly mentioned– in which the extraction of rocks or fossils is prohibited, unless properly authorised. Some autonomous regions, among them Castilla-La Mancha, have also included in the cultural heritage protection laws the totality of the fossils found in their territory. This way, the Consejería de Cultura of this autonomy, has a clear knowledge of the value of Palaeontology as a good that has to be put in the hands of the scientific community for its research. In turn, it should go back to society in the form of scientific and popular publications. A good example of this is the book “La huella del pasado. Fósiles de Castilla-La Mancha” published by the Junta de Comunidades de Castilla-La Mancha, which includes a chapter devoted to invertebrate Jurassic fossils (Goy et al. 1999a).

Taking into account that the Autonomous Region of Castilla-La Mancha has adopted its environmental competences, particularly for the legislative development and execution regarding the “environmental and ecosystem protection”, as well as “protected natural areas”, possibly the most adequate figure for the protection of the Stratotype of the Aalenian Limit is that of Natural Monument. This figure is regulated by Article 45 of Law 9/1999, of May 26, on the Conservation of Nature, issued by the Courts of this autonomous region.

The law typifying the figure of Natural Monument, allows that the protected lands can be inscribed as “unregistrable” in the Mining Record, and that it is zoned as a rural area by the urban and regional planning, giving it environmental, natural and landscape protection. However this designation permits the activities of geological research, as well as those of any other scientific discipline.

In the protected area (or alert area), it could also be prohibited, if considered convenient, all activities implying land moving, the construction of buildings or in-

frastructures different from those required by the protected area, the scientific work lacking the appropriate authorisation, the activities dedicated to the production and transport of energy, the installation of communication networks, the dumping, burying and storing of debris and liquid or solid residues, the installation of static publicity not related to the Natural Monument, etc...

### **Other close singular sites of interest to the sociocultural development of the Fuentelsaz Region**

The Fuentelsaz Section, close to a medieval castle, is located in the Señorío de Molina de Aragón, in the tourist route of the Monasterio de Piedra. This Señorío was, during the Middle Ages, a border line between the Kingdoms of Castilla and Aragón, which originated an important civil and military architecture in its area of influence. There are romanic churches, such as the one of Santa Catalina in Hinojosa, or the one of La Carrasca in Castellar de la Muela, and monasteries as the one of La Virgen de la Hoz close to the capital of the Señorío, or the Cistercian monasteries of La Buena Fuente del Sistol and Santa María de Huerta, besides the already mentioned Monasterio de Piedra. Among the military architecture stand out the castles of Molina de Aragón, in the Ruta del Cid, and those of Zafra and Corduente.

Also, near Fuentelsaz, there is a beautiful scenery, with rocky landscape and protected dense forests, such as the recently created Parque del Alto Tajo, and the Laguna de Gallocanta, which is a specific example of an unusual wetland in inner Spain, with more than 220 species of birds, about one hundred of which breed there regularly, and is considered as the most important gathering point for immigrating common cranes in western Europe.

### **Conclusions**

Summing up, for the conservation and the sociocultural development of the Fuentelsaz Section, up to now, action has been taken at the level of the autonomic and state administrations.

On one hand, taking into account all the considerations presented here, the proper steps have been taken to get the Consejería de Agricultura y Medio Ambiente of the autonomous region to prepare, in a relatively short time, a decree. This should then be accepted by the Government and the Consultive Council of Castilla-La Mancha, declaring the Fuentelsaz Section a Natural Monument.

At the same time, and through the Instituto Geológico y Minero de España (IGME), dependent from the Spanish Ministry of Environment, the Fuentelsaz Section has been included in an inventory of Geosites of exceptional interest, in the Mesozoic Series of the Betic and Iberian Ranges.

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## REFERENCES

- Cresta S., Goy A., Ureta S., Arias C., Barrón E., Bernad J., Canales M.L., García-Joral F., García-Romero E., Gialanella P.R., Gómez J.J., González J.A., Herrero C., Martínez G., Osete M.L., Perilli N. & Villalaín J.J. (2001) - Definition of the Global Boundary Stratotype Section and Point (GSSP) of the Aalenian (Middle Jurassic) and the Toarcian-Aalenian Boundary. *Episodes*, 24: 166-175, Beijing.
- García-Joral F. & Goy A. (1995) - The associations of Brachiopods from the Toarcian-Aalenian transition in the Fuentelsaz Section (Iberian Range, Spain). *Géobios*, M.S., 17: 223-228, Lyon.
- García-Joral F., Goy A. & Ureta S. (1990) - Las sucesiones de braquiópodos en el tránsito Lías-Dogger en la Cordillera Ibérica. *Cuad. Geol. Ibér.*, 14: 55-65, Madrid.
- Goy A., García Joral F. & Martínez G. (1999a) - Invertebrados del Jurásico de Castilla-La Mancha. In Aguirre F. & Rábano I. (Coord.) - La Huella del Pasado. Fósiles de Castilla-La Mancha: 163-180, Toledo.
- Goy A. & Ureta M. S. (1987) - Leioceratinae (Ammonitina) del Aaleniano inferior de Fuentelsaz (Cordillera Ibérica, España). *Boll. Soc. Paleont. It.*, 25: 213-236, Modena.
- Goy A. & Ureta S. (1991) - The lower boundary of the Aalenian in the Fuentelsaz section (Iberian Range, Spain). In Morton N. (Ed.) - Conference on Aalenian and Bajocian Stratigraphy, Isle of Skye, Birkbeck College, University of London: 33-47, London.
- Goy A., Ureta S., Arias C., Canales M.L., García-Joral F., Herrero C., Martínez G. & Perilli N. (1994) - The Fuentelsaz section (Iberian Range, Spain), a possible Stratotype for the base of the Aalenian Stage. *Misc. Serv. Geol. Naz.*, 5: 1-31, Roma.
- Goy A., Ureta S., Arias C., Bernad J., Barrón E., Canales M.L., García-Joral F., Gialanella P.R., Gómez J.J., Herrero C., Martínez G., Osete M.L., Perilli N., & Villalaín J.J. (1996) - The Toarcian/Aalenian transition in Fuentelsaz section. In Ureta S. (Coord.) - Fieldtrip Iberian Range Guide-Book (1<sup>st</sup> Toarcian 4<sup>th</sup> Aalenian Working Groups Meeting), Departamento de Paleontología, Universidad Complutense: 51-77, Madrid.
- Goy A., Ureta S., Arias C., Barrón E., Bernad J., Canales M.L., García-Joral F., Gialanella P.R., Gómez J.J., Herrero C., Martínez G., Osete M., Perilli N. & Villalaín J.J. (1999b) - The Fuentelsaz section (Guadalajara, Iberian Range, Spain): A possible Global Geosite. In Baretino D., Vallejo M. and Gallego E. (Eds.) - Towards the Balanced Management and Conservation of the Geological Heritage in the New Millennium, Sociedad Geológica de España: 60-64, Madrid.
- Herrero C. & Canales M.L. (1997) - Diversidad en los foraminíferos del tránsito Toarciense/Aaleniano en la sección de Fuentelsaz (Cordillera Ibérica). *Rev. Esp. Paleont.*, 12: 233-242, Madrid.
- Remane J., Bassett M.G., Cowie J. W., Gohrbandt K. H., Lane R. H., Michelsen O. & Naiwen W. (1996) - Revised guidelines for the establishment of global chronostratigraphic standards by the International Commission on Stratigraphy (ICS). *Episodes*, 19: 77-81, Beijing.
- Wimbledon W.A.P., Ishchenko A.A., Gerasimenko N.P., Karis L.O., Suominen V., Johansson C.E. & Freden C. (2000) - Proyecto Geosites, una iniciativa de la Unión Internacional de las Ciencias Geológicas (IUGS). La ciencia respaldada por la conservación. In Baretino C., Wimbledon, W.A.P. & Gallego E. (Eds.) - Patrimonio Geológico: Conservación y Gestión, Instituto Tecnológico y Geominero de España: 73-100, Madrid.